Now, Hering[1] has particularly investigated this portion of the subject, and explains the existence of two forms of colour-blindness as follows. He finds that persons with a normal colour-vision can be divided into two groups. The one class perceive yellow, the other blue, with exceptional ease, probably owing to a difference in the pigmentation of the media of the eye. The difference between the two groups is best seen with spectral green; for a green can be found which appears at the same time yellow-green to the one, blue-green to the other. To an observer with strong yellow vision, almost the whole of spectral red appears to be tinged with yellow, whilst a member of the second group, whose strong sense of blue prevents his seeing the yellow, pronounces the greater part to be pure red. Thus, the pure red and the pure blue are radically different colours for the two groups. Now, it is found that the pure red and the pure green formed for an observer with a strong sense of yellow appear grey to one who is what is called green-blind; whilst, on the other hand, the pure red or the pure green of the observer with a strong blue sense appears colourless to one who is red-blind. A red which is invisible to one who is "red-blind" is evidently coloured to a patient who is green blind, and he speaks of the colour he sees as red. But if a minute proportion of blue is added, the red gradually becomes purer until it becomes free from yellow to those of us who have a strong yellow sense. As the red becomes purer, our green-blind patient complains that the "red" is fading, and when finally the red is quite pure he matches the colour he sees with a grey, and says that the colour has gone. Thus, there is no fundamental difference between the red- and the green-blind. Neither group can perceive red or green. The only difference between them is one which we find amongst normal-sighted persons—namely, a different visual acuity for yellow and blue. The "red" of the green-blind is in reality the secondary sensation of yellow yielded by almost all the reds in nature, differing from the ordinary yellow in its limited power of exciting white. This peculiar yellow he has learnt to associate with what others around him call red, and he only betrays his affliction when all yellow is eliminated from the colour he calls red. Thus, a consideration of colour-blindness again leads us to throw red and green, blue and yellow, together into two groups as primary colour sensations.

Simultaneous contrast is touched on very superficially, and successive contrast is scarcely mentioned, yet the author again grasps at the three-colour theory to explain the few phenomena he mentions. Yet it is notorious that the Young-Helmholtz theory fails to afford any adequate explanation of the phenomena of contrast. It was by an ingenious contrast experiment that Hering produced such a striking confirmation of his views before the Physiological Congress at Basle, and placed the three-colour theory in a dilemma from which its ablest exponents have not yet succeeded in extracting it.

In conclusion, the book before us is an admirable summary of a valuable series of experiments. We can scarcely imagine that it will appeal to the public in general. But it should be read by those who are interested in the phenomenon of colour-vision, and the fact that the author frankly accepts the three-colour theory and ignores the work of Hering does not, in our opinion, detract from its value. For the book thus becomes an admirable statement of the strongest portion of the physical theory of colour by one of the ablest of English physicists.

H. H.

POSITIVE SCIENCE AND THE SPHINX.

Riddles of the Sphinx. A Study in the Philosophy of Evolution. By a Troglodyte. (London: Swan Sonnenschein, 1891.)

THESE be old old riddles that the Sphinx propounds and the Troglodyte attempts to guess, in the volume before us; none other, indeed, than the What, Whence, and Whither of man and of the world. There have been other guesses in the past, there will be other guesses while time lasts; each guesser thinks his own guess nearer the true answer than any other; his neighbours mostly smile, unless his guess chances to be something like their own; and the Sphinx looks on with stony stare, imperturbable, giving no hints.

So soon as man, as man, looked out upon the world, and began dimly to realize the first personal pronoun, the nascent reason, or, if the phrase be preferred, intellectual faculty, demanded, for the first time in the history of the development of consciousness, an explanation. Man, then as now the chief centre of interest to man, must thenceforward not only live and act, but must seek to explain his life, and his activity. Yesterday the tribe-chief went forth a living man, feared by all: to-day his body is brought back, helpless, lifeless, and a hog spurns it with his snout. How account for this? How explain this change? Something there was about the man yesterday which made him totally different from the mere mass of clay that to-day already needs hustling out of sight. That something, call it soul, spirit, energy, life, what you will, has departed. Whither has it gone?

This question, eminently natural, almost inevitable, opened the way for reason's first blunder to enter and to become a fruitful mother of children. Reason, in the exercise of the new-born analytic faculty, distinguished between the mere body and the informing something through which it was a living body; between the material substance and the spirit-energy which was associated with that substance during life. But reason also jumped to the conclusion that what were distinguishable in thought were also capable of separate existence in fact. The matter remains in the corpse, but the something, the spirit-energy, has escaped, to lead a distinct and independent existence. In justification of this conclusion the phenomena of dreams were no doubt adduced as evidence. While the chief's body was lying stark and stiff, his true self, his spirit-energy, appeared by night to more than one of his chosen followers. Thus the dream seemed to support the false conclusion of the nascent reason, which had not yet learnt to distinguish without dividing.

It has cost positive science much labour, and not a few hard blows, to establish, by detailed work in physical science, biology, neurology, and psychology, the illegitimacy of this conclusion. Now we distinguish further, but no longer divide. We distinguish between the material substance of the body and the energy of molecular motion during life; and, further, between the molecular motion of the grey matter of the cerebral hemispheres and the concomitant manifestation of consciousness. But although consciousness is distinguishable from molecular energy (and the distinction is absolute), it is not, so far as positive science can say, divisible therefrom. No physicist holds that the special modes of energy—we mean the particular groupings and interactions of energy—which characterize the functioning of a man's brain, escape from the molecules at death, and henceforward persist divorced from matter. We cannot, however, add that no psychologist holds an analogous doctrine concerning consciousness. But we contend that no psychologist is justified *on positive grounds* in holding such a view. That something called soul or spirit escapes from a man's body at death, and henceforward persists, divorced alike from matter and energy, is a view to which positive science as such gives no support. It is held by those who hold it on quite other grounds. The conclusion to which positive science points (and we include among positive sciences psychology, which deals with consciousness as existent) is that consciousness, though distinguishable from energy, is known only in association with certain forms of energy in organic tissues.

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[1] "Zur Erklärung d. Farbenblindheit" (Prag, 1880); "Ueber Individuelle Verschiedenheiten des Farbensinnes" (Prag, 1885); "Eine Vorrichtung z. diagnose d. Farbenblindheit," "Ueber d. Erklärung d. periphären Farbenblindheit," "Einseitige Störungen d. Farbensinnes," *Archiv f. Ophthalmologie*, xxxvi.

But this is a conclusion which is ignored by the Troglodyte. He professes to give us a "philosophy of evolution" which he himself describes as "the first perhaps which accepts without reserve the data of modern science." His theory of a Transcendental Ego; his suggestion that "matter is an admirably calculated machinery for regulating, limiting, and restraining the consciousness which it encases"; his conception of a graduated immortality, from that of an amœba up to that of man; his attempted rehabilitation of the view that force-atoms are monads "endowed with something like intelligence, and thus enabled to keep their positions with respect to one another"; all this, and much besides, seems to us completely off the lines of modern scientific advance.

But it may be said that such conceptions, though unnecessary for positive science, may be necessary for a philosophy which endeavours to go beyond and get behind science. In reply to this we can only say that we regard such conceptions as not only unnecessary to positive science, but unwarrantable intrusions into her domain. They form part of a different scheme of thought. The muddling together of positive and metaphysical conceptions is provocative of nothing but confusion and bad temper.

The introductory chapters of his first book, in which the author attempts to hound on positive science from agnosticism, through universal scepticism, to a gloomy pessimism, seem to us laboured and inconclusive, though there are incidental positions here and elsewhere with which we are in complete accord. With dogmatic Agnosticism and the Cult of the Unknowable (capital letters indispensable) we have but little sympathy. But this is no necessary part of the attitude of positive science, which seems to us briefly as follows. In the first place its followers take their start from the measurable and verifiable base-line of perceptual experience, from the ordinary facts of daily observation; and they utterly refuse, at this stage of the inquiry, to listen to the metaphysicians who hoot from their cloud-land, "But you haven't yet proved the existence of matter, or explained how it is possible to perceive or know anything at all." Starting, then, from the base-line of perceptual experience, they analyze phenomena, digging down by wise abstraction and the ignoring of unessentials, to deeper and deeper concepts, until they arrive at those universal abstracts which cannot be got rid of in thought without reaching nonentity. Happy they who in this procedure escape the analyst's fallacy—the supposition that the results of abstraction have a fuller reality than the phenomena with which they started. The analyst needs often to be reminded that the perceptual rose, with its delicate scent, its rich colour, its soft petals, is certainly not less real than the vibrating molecules which remain to his thought when, as physicist, he has stripped it of all its own peculiar charms.

Thus positive science in its deepest analysis brings us down to matter, and energy, and consciousness. If a number of metaphysical questions are intruded at all sorts of stages during this process, the result will be such confusion as the Troglodyte unconsciously exemplifies in his chapter on scepticism, a chapter in which some stress is laid on, and some capital made out of, the false psychological conclusion that conceptions cannot be derived from experience. Should the author ever come to grasp that the law of psychogenesis is one and indivisible, and sweeps through perceptual and conceptual processes alike, he will have to rewrite much of the "Riddles of the Sphinx." But, as he himself tells us, "the minds of most men are fortresses impenetrable to the most obvious fact, unless it can open up a correspondence with some of the prejudices within."

When positive science has dug down to basal conceptions, then, and not till then, in logical order (but, of course, far earlier in historical order) arises the question, "But how does it all come about? What is the origin and meaning of it?" We quite agree with the Troglodyte that this question *must* arise in the mind of every man in so far as he is a thinking man. The question, "How does it all come about?" however, presents two faces. It may mean, "How can we explain the fact of *knowing?*" And the solution of this problem is, we agree with Mr. Shadworth Hodgson in maintaining, the true business of philosophy. But even supposing that philosophy explains in some sense the process of knowing, there still remains the question in its further aspect, "But how does it all come about?" To this question, positive science as such answers, or should answer, humbly, and with no parade of capital letters, "I do not know."

And is that the end of the matter? So far as positive science at present goes, Yes. But man, the questioner, still remains; and Reason, true to her first impulse, still demands an explanation. Of the explanation afforded by revelation this is not the place to speak. But, quite apart from the fact of revelation, the explanation said to be revealed still stands as a product of the human mind. And he is a bold man, if not a foolish, who, having regard to the past history of human thought on the question, lightly sets aside the conception of a *Causa causarum* to whom we may attribute *symbolically* all the higher attributes of man; not because personality, wisdom, love (the symbols we employ), can truly describe or define that which passes man's comprehension, but because being man we can no other. Man alone in the organic world is capable of ideals, and for generations the name of God has stood for man's central ideal of power and perfection. And it seems to us that the sum and substance of positive criticism as applied to man's conceptions of that which admittedly lies beyond the reach of positive science comes to this: "You must frankly acknowledge and confess that such conceptions are symbolic and ideal." But if symbolic and ideal we must expect the symbolism to be variable in different ages, among different peoples, and even in different individuals. Hence (apart from revelation) the only indefensible attitude is that of inelastic dogmatism, positive or negative.

In conclusion, we may say that the "Riddles of the Sphinx" are in this work treated with considerable, though frequently misguided, power. The conception of evolution as a tendency towards an ideal of perfect individuals in a perfect society is good, and is in parts well worked out. That many will be found to acquiesce in the author's solutions of the old problems of life we think exceedingly doubtful. Nor do we think that the solutions will prove of lasting value. It is futile to attempt to preserve the new wine of positive science in the old bottles of prescientific metaphysics. The new wine must be preserved in new bottles. In other words, a new metaphysics must be and is being elaborated, in special relation to the newer aspects of scientific thought.

C. LL. M.

ANALYTICAL METHODS OF AGRICULTURAL CHEMISTS.

Proceedings of the Association of Official Agricultural Chemists, 1890. (Washington: United States Department of Agriculture.)

THIS is a Report of the Seventh Annual Convention of the Association, under the Presidentship of Mr. M. A. Scovell, and with Mr. H. W. Wiley as Secretary. The objects of the Association are to secure uniformity and accuracy of methods, results, and modes of statements of analyses of manures, soils, cattle foods, dairy products, and other materials connected with agricultural industry; and to afford opportunity for the discussion of matters of interest to agricultural chemists. In the words of a past President, it aims at laying "a foundation so solid, that every Court in this land must respect its conclusions, and every analytical chemist, whether he lives in this country or elsewhere, must be forced either to practice or admit the advantages and correctness of our system of analyses." A study of the programme and of the proceedings shows that the objects have been most carefully and conscientiously kept in view, and that all the working members have been most thoroughly imbued with the spirit of the Association.

The reports submitted for the consideration of the meetings, all drawn up by experts, and incorporating the work of many members, were as follows: on the determination of nitrogen; on analysis of dairy products; on analysis of potash; on analysis of cattle foods; on analysis of sugar; on analysis of phosphoric acid; on analysis of fermented liquors; and a report of a Committee on foods and feeding-stuffs.

As an example: for the report on the determination of nitrogen in manures, three samples, containing nitrogen in different states of combination, were prepared, and sent to the members for analysis by various official methods. Twenty-two reported the results obtained by Kjeldahl's method on one sample, the same number the results of Kjeldahl's method modified for nitrates on two samples, and a less number gave results by the Ruffle method, the soda-lime method, and Dumas's method on one or more of the samples. The whole of the results are collated, with the remarks of the analysts thereon, so that data are obtained for testing the accuracy of the methods under various conditions, and eliminating personal factors. Various suggestions for the improvement or simplification of the processes are made and discussed, and some of them recommended for systematic trial during next year. Similar good work is done for the other Committees.

The remarks of the Committee on ways and means for securing more thorough chemical study of foods and feeding-stuffs, are particularly worthy of attention, pointing out, as they do, the deficiencies in present methods of analysis, and the absolute necessity of more exact methods and more accurate study of the proximate principles contained in foods, and of their physiological value. As a contribution towards this knowledge, Mr. W. E. Stone sends a paper on the occurrences and estimation of the pentaglucoses in feeding-stuffs, in which he shows that bodies yielding furfurol, and therefore presumably pentaglucoses, are present in grass, straw, linseed meal, and a great many other feeding-stuffs. Among the points which are noticed, and which should be known to all analysts, is the fact that cotton-seed meal, often used in mixed manures in the Southern States, is completely soluble in nitric acid with a little hydrochloric acid, but that the solution does not yield all its phosphoric acid to ammonium molybdate.

Should such a Bill as that introduced by Mr. Channing, for the better prevention of the adulteration of manures and feeding-stuffs in this country, ever become law—and the Government has promised to take up the matter—the formation of such an Association of Official Agricultural and Analytical Chemists in this country would be almost a necessity, and it seems that the Institute of Chemistry is the proper body to arrange the organization of such an Association.

GEOLOGICAL RAMBLES ROUND ABOUT LONDON.

Hand-book of the London Geological Field Class. By Prof. H. G. Seeley, F.R.S. (London: G. Philip and Son, 1891.)

THIS little book is a record of excursions similar in some respects to those collected in the volume of Geological Excursions which was noticed in these columns on June 18 (p. 149). But there are points of difference. This hand-book deals with a more limited area, being practically restricted to the south-east of England; it has a purpose more definitely educational. The latter may